Aviation Medicine

from the aeronauts to the eve of the astronauts

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Cover: Dr. John Jeffries (1744–1819), of Boston, is generally credited with being the first American to go aloft in the interests of scientific research and was the first person, in company with balloonist Jean Pierre Blanchard, to make an overwater flight in crossing the English Channel in 1785.

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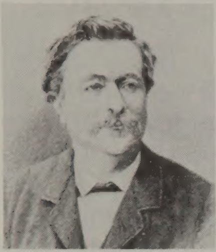
Only sixty years ago, at the close of World War I, Dr. Thomas R. Boggs, a medical consultant to the Air Service of the American Expeditionary Forces, expressed concern that the limited postwar opportunities in aviation would adversely affect the growth of the field of aviation medicine. This, however, turned out not to be the case. Rather, the significant advances in aviation have challenged the medical profession to help protect the health and safety of pilots, crews, and passengers. This exhibit traces the growth of aviation medicine, from its rudimentary beginnings in the accounts of high altitude sickness among mountain climbers to the eve of space flight.

Early Concern with Altitude Sickness and Atmospheric Pressure

A variety of causes for altitude sickness are cited in the mountaineering literature of the 17th and 18th centuries, including poisonous exhalations from the vegetation as well as the rarity of the air. Denis Jourdanet (b. 1815), a French physician and friend of Paul Bert (1833–1886), first suggested in 1875 that there might be insufficient oxygen at high altitudes to saturate the hemoglobin. Three years later, in his publication *La Pression Barométrique,* Bert confirmed Jourdanet's hypothesis and proved that altitude sickness was due to imperfect oxygenation of arterial blood, a result of the diminished partial pressure of oxygen at high altitudes.

Shortly after the Montgolfier brothers sent their first hot-air balloon aloft in June, 1783, many scientists and physicians began experimenting in the art of aeronautics. On October 15, 1783, Dr. Jean-Francois Pilâtre de Rozier became the first person to ascend in a balloon. He was also the first to die in a ballooning accident. Edward Jenner, John Morgan, and other late 18th century physicians, dabbled in ballooning, but credit for being the first to go aloft to conduct "a full

investigation of the nature and properties of the atmosphere which surrounds us" is given to John Jeffries, of Boston. Jeffries' ascent, in 1784, was followed by his flight with Jean Pierre Blanchard over the English Channel in January, 1785, the first over water flight in aviation history.


Paul Bert (1833–1886)

In 1875, Gaston Tissandier, Theodore Sivel, and Joseph Croce-Spinelli, who were assisting Paul Bert in his studies, became the first aeronauts to use oxygen in a balloon ascent. This adventure ended in tragedy, all of them having lost consciousness and only Tissandier returning to earth alive. Hermann von Schrötter (1870–1927), the Austrian physiologist, was another important contributor to high altitude physiology and, beginning in 1894, he made a series of high altitude balloon ascents with oxygen equipment that he devised. He also developed the first oxygen mask for airmen. It was the Anglo-American Pike's Peak Expedition of 1911 and its thorough study of physiological adaptation to low atmospheric pressures that placed the imprimatur of modern science on the work of Paul Bert.

Aviation Medicine in World War I

In general, there was little concern for medical problems relating to flight from the time of the Wright brothers' flight in 1903 to the first World War. European countries had organized special medical services for their air forces before the Americans, but in 1917 a group of ophthalmologists and otolaryngologists laid the foundation of American aviation medicine by establishing standards for the Army Air Medical Service. Initial pilot selection left something to be desired because of an overemphasis on the testing of vestibular function and visual testing. Still, the roots of aviation medicine as a specialty are found in World War I. Among the important preliminary steps taken was the establishment, in 1918, of the Air Service Medical Research Laboratory at Hazelhurst Field, Mineola, Long Island, out of which grew a school for flight surgeons which later became the Army School of Aviation Medicine. Important contributors to the development of aviation medicine during World War I were Theodore C. Lyster, William H. Wilmer, Yandell Henderson, and Edward C. Schneider.

The Barany Chair

Aviation Medicine Between the Wars, 1919-1938

This was a productive period as scientists from several countries conducted research into problems of oxygen supply, pressure suits and pressurized cabins, the medical effects of acceleration, and blind flying. In the United States, the Aero Medical Research Laboratory at Wright Field was founded. At this facility, from 1934 to 1940, Dr. Harry G. Armstrong became the acknowledged leader of medical research in aviation and undertook many important studies including problems relating to high altitude hypoxia and aeroembolism, and the medical effects of acceleration. Armstrong's work on aeroembolism led to the discovery that unless body fluids are adequately protected in a sealed, pressurized suit or cabin, they will vaporize at 63,000 feet (known as the "Armstrong line").

In 1926, flight surgeon David A. Myers and pilot William C. Ocker solved the serious problem of "blind flying" and revolutionized instrument flight instruction by introducing the "Ocker Box" with its gyroscope and turn and bank indicator. Another significant event in 1926 was the passage of the

Air Commerce Act, providing for the examination and licensing of civilian planes and pilots. In 1929, primarily through the efforts of Dr. Louis H. Bauer, the Aero Medical Association (now the Aerospace Medical Association) was founded, and in 1930 this organization started publication of the *Journal of Aviation Medicine* (now *Aviation, Space, and Environmental Medicine*), the first periodical devoted to the specialty. By the middle and late '30s several nations were competing for altitude records. Using a primitive pressurized cabin, Mario Pezzi won the honors for Italy in 1938 by reaching an elevation of 56,046 feet.

Harry G. Armstrong
(1899 –)

Aviation Medicine in World War II, 1939-1945

Aviation medicine came of age in World War II. The major air powers undertook extensive research projects, and flight surgeons studied and became involved with the problems experienced by flight crews. As planes flew higher and faster, aviation medicine had to take steps to minimize the risk of death and injury. The mechanical and physiological complexities of high altitude oxygen equipment were eventually overcome and pressure breathing diluter-demand equipment was developed. Initially, pressurized cabin aircraft were built in small numbers – chiefly for photoreconnaissance. The B-29 Superfortress was the first pressurized aircraft to be produced in large numbers.

For the first time, war neuroses and combat fatique were given considerable attention; important studies were conducted among the 8th Air Force personnel. The effects of radial acceleration ("blackouts") in sharp turns and pull-outs led to the development of numerous experimental anti-g devices and suits. At the close of the war, the U.S. Army Air Force made a concerted effort to gather information and equipment pertain-

ing to German aviation medical research. A number of the German scientists who worked at the U.S. Air Force's Aero Medical Research Center at Heidelberg eventually moved to the United States.

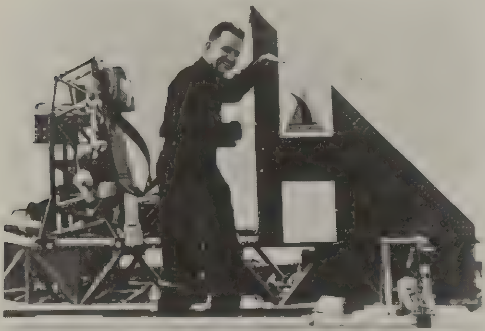
Pneumatic lever anti-g suit designed by Harold Lamport

The Jet Age

Introduction of the jet engine presented few novel medical problems. The most significant of these was the noise of jet engines. Some old problems were aggravated by the turbine power plants that drove aircraft higher and faster and for longer distances. The most serious problem in flying with pressurized equipment was the possible loss of cabin pressure at high altitudes. If equalization of the internal and external pressure takes place in less than one second, it is called explosive decompression; the sudden rush of air can blow an individual out of a plane. And, of course, anoxia is also a threat above 40,000 feet. The two jet Comet aircraft disasters in 1954 are striking examples of the violent destructive forces that are unleashed by massive structural failure of a pressurized cabin. The reconstruction and experimental study of these two aircraft accidents by a medical team is a good example of the sophistication and technical expertise that has developed since World War II.

The physical effects of radial and linear acceleration were increased in jet aircraft and led to the development of complex anti-g suits and to John P. Stapp's studies of decelerative forces on the rocket powered linear decelerator. Automatic ejection systems to overcome the g forces were also

developed and permitted the pilot to clear the plane while protecting him from wind-blast, wind-drag deceleration, violent spinning, and anoxia during high altitude bail outs. As aviation medicine entered the age of space flight, it was again faced with additional environmental conditions. Extended periods of weightlessness, radiation, and sealed environments, were among the new challenges.



John P. Stapp and the linear accelerator

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